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Automatic [self-activated] power-on device for high-frequency surgical devices

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The invention concerns an assembly for automatic power-on of the high-frequency (HF) voltage of a high-frequency surgical device. Such known devices operate in the manner that, when the patient is touched by the (active) operation electrode, an auxiliary current circuit is completed by the patient, and thereby the control potential of an amplifying tube is affected, which in turn controls a relay to switch on the high-frequency generator. In known devices, the auxiliary current circuit is configured to have relatively low resistance. In this manner, however, an irritating current to the patient may arise.

It is known that a rectifier effect may occur during a cutting process because of spark formation at the contact location between the active electrode and the patient. When the direct-current (DC) circuit is completed, the DC voltage thus arising may lead to capacitance irritation. In order to prevent such a DC path via the output circuit of the device, the high-frequency current circuit in all surgical devices is interrupted for DC by means of a capacitor. The new fact in this connection is the recognition that the above-mentioned DC voltage may be 150 Volts or more in conventional devices. If the auxiliary current circuit of the automatic switching device is configured to be of a low resistance, than this voltage may result in a relatively strong irritating current, which causes undesired irritation (muscular twitch) to the patient.

In order to prevent this disadvantage, it is proposed according to the invention to configure the auxiliary circuit such that the DC resistance imposed between active and neutral electrodes is at least 100 kΩ, and preferably in the realm of several MΩ. The invention therefore takes into account the

higher technical circuit expense that requires a high-resistance in order to prevent the resultant effects of the automatic power-switching device unpleasant to the patient. For this, one must ensure that the above-mentioned DC resistance, as in a known assembly, may be co-determined by means of the low-resistance grid-cathode path of a switching vacuum tube.

Embodiment examples of the invention will be explained in the following using the Figures.

According to Figure 1, the output of a high-frequency generator **1** represented merely by a circuit symbol is grounded on one side, and can with its second pole be connected with the active electrode **3** of the high-frequency surgical device via a switch **2**. The neutral electrode **5** resting on the patient **4** is also grounded. A capacitor **6** serves for DC interruption of the treatment circuit.

A DC path is established between active electrode **3** and neutral electrode **5** via a high-frequency blocking choke **7**, an auxiliary-voltage source **8**, and two high-resistance resistors **9, 10** that complete a circuit via the patient when he/she is touched by the active electrode **3**. The DC current then to be applied creates a voltage drop at the resistor **10** that switches a relay **12** via an amplifier **11** when the magnitude is sufficient whose operational contact **2** completes the high-frequency circuit.

Upon application of treatment current, DC voltage arises to the patient through the rectifier effect that is formed between the active electrode and the treated tissue that drives an additional DC current via the auxiliary current circuit. The invention now involves the recognition that the DC voltage arising to the patient is significantly higher than the DC voltage from the auxiliary-voltage source **8**, which is 12V in the example. During experimentation with a conventional surgical device, a DC voltage of about 150V to the patient was measured. Dimensioning of the auxiliary circuit with respect to a calculation of the DC current within the auxiliary circuit must be primarily based on this voltage, whose existence at this magnitude was not yet known. In the case of the example, values of 10 and 1 MΩ were selected for resistors **9** and **10**.

For the indicated dimensioning, the operating threshold sensitivity of the automatic circuit that may be expressed by a specific highest patient compensating resistance, i.e., the automatic circuit will always engage when the contact resistance is below the maximum compensating resistance corresponding to the sensitivity. It may be desirable for specific application cases, or for safety reasons, to reduce the operating threshold sensitivity. This may be performed technically either by a resistor **14** connected in parallel through the switch **13** to the resistor **10**, or by reduction in voltage at the auxiliary current source **8**.

The capacitor **15** interacts with the resistor **9** so that low-frequency alternating-current and DC interference impulses that might reach the active electrode do not cause adequate voltage at the grid of the input vacuum tube of the amplifier **11**. So that no switch-on delay caused by the time-constant in the grid circuit occurs otherwise via the capacitor **15** after removal of the electrode **3** from the patient **4**, the relationships are constructively selected such that the grid current of the input tube of the amplifier **11** after a slight increase in the grid voltage occurs, and thus prevents further charging of the capacitor **15**.

The automatic power-on device may be implemented as a separate component in order to be able to retrofit surgical devices. It may also be included in the circuit of the surgical device. Figure 2 shows the combination of a separate component with a surgical device. Only a few components are shown of the surgical device indicated by the dashed rectangle **20** such as the generator tube **21**, the oscillation circuit **22, 23**, the decoupling inductor **24**, and the separating capacitor **25**. The sockets **26**,

27 serve to connect the active electrode 3 and the neutral electrode 5. A foot switch (not shown) is usually connected to the sockets **30, 31** in conventional devices. Upon actuation of the foot switch, both sockets **30, 31** would be short-circuited, and the relay **32** would receive current and would close its operating contact **33** in the anode voltage line of the generator tube **21**. Instead of the foot switch, the automatic power-on device is connected to the sockets **30, 31**, and namely its switching contact **34** that is actuated by the transistor relay **35** shown schematically. The elements **7, 9, 10,** and **15** coincide with the elements with the same reference indices from Figure 1. The blocking choke **7** is mounted within the apparatus housing **20**. The amplifier tube **36** receives its anode voltage from a power supply **37** shown schematically whose operating voltage supplies the heating voltage source of the surgical device. The grid current set results at a grid voltage of 1.5V for power-up with minimal delay. The auxiliary voltage effective for the auxiliary circuit, and thus the operating threshold sensitivity of the power-up device, may be altered at the potentiometer resistance **38**. A quiescent potential negative with respect to the cathode is transmitted to the grid of the tube **36** with the help of the resistors **39, 40**.

A test pushbutton **42** that allows a function check when the button is pressed is provided to test the automatic circuit. Thus, a test current circuit is formed via the pre-switched patient replacement resistance **43** instead of the conventional current path via the patient.

Patent Claims:

1. Automatic power-on device for high-frequency surgical devices with a direct-current (DC) path containing a DC-voltage source and consisting of a path between active and neutral electrodes, **characterized in that** the resistance of the DC path is at least 100 kΩ, and preferably more than several MΩ.

2. Device as in Claim 1, characterized in that a portion of the resistance in the grid circuit is assigned to an amplifier tube, and that undesired alternating-current voltages be kept as small as possible for this grid circuit through a capacitor in connection with another portion of the DC current path by means of voltage-component interaction.

3. Device as in Claim 1 or 2, characterized in that effective means for a function check is provided independent of the operation of the active electrode to actuate the power-up device.

Documents taken into account:

Patent Document No. 7550 of the Office for Inventions and Patents in the Soviet Occupation Zone of Germany [former East Germany];

USA Patent Document No. 2 827 056.

To this, one page of Figures.